



DEFENSE LOGISTICS AGENCY
LAND AND MARITIME
P.O. BOX 3990
COLUMBUS, OHIO 43218-3990

1 October 2025

MEMORANDUM FOR MILITARY/INDUSTRY DISTRIBUTION

SUBJECT: Initial Draft(s) of: MIL-DTL-3533C AMD 2, MIL-DTL-5516D AMD 1
Project Number(s): 5330-2025-008, 5330-2025-009

The initial draft(s) for the subject document(s), is now available for viewing and downloading from the DLA Land and Maritime-VA Web site:

<https://landandmaritimeapps.dla.mil/programs/milspec/default.aspx>

Major changes to this document(s) include updated reference from withdrawn NGS to superseding NGS.

Concurrence or comments are required at this Center within 30 days from the date of this letter. Late comments will be held for the next coordination of the document. Comments from military departments must be identified as either "Essential" or "Suggested". Essential comments must be justified with supporting data. Military review activities should forward comments to their custodians of this office, as applicable, in sufficient time to allow for consolidating the department reply. Lack of response to this draft will be construed as concurrence.

If this document(s) is of interest to you, please provide your comments or suggested changes. The point of contact for this document is Mr. Donovan Wells, phone number 614-693-0794, e-mail Donovan.Wells@dla.mil, or may be mailed via the US Postal Service to DLA LAND AND MARITIME, ATTN: VAI (Attention: Donovan Wells), P.O. Box 3990, Columbus, OH 43218-3990.

Sincerely,

-/ Signed/-
MUHAMMAD AKBAR
Chief,
Active Devices/Interconnection Branch

NOTE: This draft, dated **22 Sept 2025** prepared by **DLA – CC**, has not been approved and is subject to modification.
DO NOT USE PRIOR TO APPROVAL. (Project 5330-2025-008)

INCH-POUND

MIL-DTL-3533C
w/AMENDMENT 2
DRAFT
SUPERSEDING
MIL-DTL-3533C
w/AMENDMENT 1
25 November 2024

DETAIL SPECIFICATION

RUBBER, SYNTHETIC; SHEET, STRIP, AND MOLDED

Inactive for new design after 27 June 2001

This specification is approved for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the requirements for sheet, strip and molded synthetic rubber for use as torpedo gasket material.

1.2 Classification. Synthetic rubber is of the following types and grades as specified (see 6.2).

Type I - O-Rings
Type II - Molded parts (other than O-Rings), sheet and strip
Grade A - Medium hard
Grade B - Medium soft

2. APPLICABLE DOCUMENTS

2.1 General. The documents listed in this section are specified in sections 3 and 4 of this specification. This section does not include documents cited in other sections of this specification or recommended for additional information or as examples. While every effort has been made to ensure the completeness of this list, document users are cautioned that they must meet all specified requirements of documents cited in sections 3 and 4 of this specification, whether or not they are listed.

2.2 Government documents.

2.2.1 Specifications, standards, and handbooks. The following specifications and standards form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

Comments, suggestions, or questions on this document should be addressed to: Commander, DLA Land and Maritime, Attn: VAI, P.O. Box 3990, Columbus, Ohio, 43218-3990 or email: FluidFlow@dsc.dla.mil. Since contact information can change, you may want to verify the currency of this address information using the ASSIST Online database at <https://assist.dla.mil>.

AMSC N/A

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FSC 5330



FEDERAL STANDARDS

FED-STD-601 - Rubber, Sampling and Testing

DEPARTMENT OF DEFENSE STANDARDS

MIL-STD-190 - Identification Marking of Rubber Products

(Copies of these documents are available online at quicksearch.dla.mil)

2.3 Non-Government publications. The following documents form a part of this document to the extent specified herein. Unless otherwise specified, the issues of these documents are those cited in the solicitation or contract.

AMERICAN SOCIETY OF MECHANICAL ENGINEERS (ASME)

ASME B46.1 - Surface Texture (Surface Roughness, Waviness, and Lay)

(Copies of this document are available from www.asme.org.)

AMERICAN SOCIETY FOR QUALITY (ASQ)

ASQ Z1.4 - Sampling Procedures and tables for Inspection by Attributes

(Copies of this document are available from www.asq.org.)

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D395 - Standard Test Methods for Rubber Property - Compression set
ASTM D413 - Standard Test Methods for Vulcanized Rubber and Thermoplastic
Elastomers - Tension
ASTM D573 - Standard Test Methods for Rubber - Deterioration in an Air Oven
ASTM D624 - Standard Test Method for Tear Strength of Conventional Vulcanized
Rubber and Thermoplastic Elastomers
ASTM D746 - Standard Test Method for Brittleness Temperature of Plastics and
Elastomers by Impact
ASTM D1329 - Standard Test Method for Evaluating Rubber Property - Retraction at
Lower Temperatures (TR Test)
ASTM D2240 - Standard Test Method for Rubber Property - Durometer Hardness

(Copies of these documents are available from www.astm.org.)

SOCIETY OF AUTOMOTIVE ENGINEERS (SAE)

SAE ARP5316 - ~~Storage of Elastomer Seals and Seal Assemblies which Include an
Elastomer Element Prior to Hardware Assembly~~
SAE AS568 - Aerospace Size Standard for O-Rings

(Copies of these documents are available from www.sae.org.)

INTERNATIONAL ORGANIZATION FOR STANDARDIZATION (ISO)

ISO 3601-3 - Fluid Power Systems - O-ring - Part 3: Quality Acceptance Criteria

(Copies of these documents are available online at www.iso.org.)

2.4 Order of precedence. Unless otherwise noted herein or in the contract, in the event of a conflict between the text of this document and the references cited herein, the text of this document takes precedence. Nothing in this document, however, supersedes applicable laws and regulations unless a specific exemption has been obtained.

3. REQUIREMENTS

3.1 Material. Synthetic rubber furnished under this specification shall be a vulcanized elastomeric compound which is resilient, oil and salt water resistant and shall not adhere to nor cause corrosion of metal parts to which it is assembled.

3.2 Forms. Synthetic rubber shall be furnished in sheet, strip, cut, or molded form as specified (see 6.2).

3.2.1 Sheet and strip. Unless otherwise specified in the contract or order, the following dimensions and tolerances shall apply. The width of sheet material shall be 36 inches plus or minus 1 inch and the width of strip material as specified with tolerances of plus or minus 5 percent. The length shall have a tolerance of plus or minus 1 percent and tolerances on thickness shall be as shown in Table I.

TABLE I. Tolerance in thickness.

Thickness – inch (mm)	Tolerance – inch (mm)
Less than .0625 (1.59)	±.010 (.25)
.0625 (1.59) to .125 (3.18), inclusive	±.016 (.40)
Over .125 (3.18) to .500 (12.7), inclusive	±.031 (.80)
Over .500 (12.7) to 1.000 (25.4), inclusive	±.047 (1.20)
Over 1.000 (25.4)	±.063 (1.60)

3.2.2 Cut or molded parts. Shape, dimensions and tolerances shall be as specified on the drawing or in the contract or order.

3.3 Physical requirements. The synthetic rubber material shall conform to the physical requirements specified in Table II.

3.4 Performance.

3.4.1 Crush test. All O-Ring material when tested as specified in 4.4.4 shall be capable of withstanding high compressive loadings without cracking or otherwise disintegrating.

3.4.2 Permanent set. When tested for permanent set as specified in 4.4.5, the samples shall show no evidence of splitting or breaking.

3.4.3 Low temperature flexibility. Samples after being subjected to the test described in 4.4.7 shall show no visible signs of cracks, checks, or other damage.

3.4.4 Adhesion to and corrosion of metal. When tested in accordance with 4.4.8, the specimens shall be readily separated from the metal with which they have been in close contact and shall not cause corrosion pitting of such metal. A slight discoloration of the metallic contact surfaces will be acceptable.

3.5 Finish.

3.5.1 General.

3.5.1.1 Finish and trimming. Mold flash shall be removed in such a manner that the pieces conform to the requirements specified herein and to the applicable drawing or Military Standard.

3.5.1.2 Sealing surfaces. Sealing surfaces shall be smooth and free from all defects, blemishes, or irregularities except as permitted on the applicable drawing or Military Standard. Inspection shall be in accordance with ISO 3601-3. The entire surface of the O-Ring is considered as a sealing surface.

3.5.2 O-Rings. Any method used to trim mold flash from O-Rings shall not remove any of the original molded finish of the ring. Unless specifically stated otherwise, the cross-sectional dimensions of the flash remaining after trimming shall not exceed .003 inch (.076 mm) radially and .005 inch (.127 mm) circumferentially (or laterally).

3.5.3 Minor surface defects. Minor surface defects that do not affect serviceability of the material shall not be cause for rejection.

3.6 Identification.

3.6.1 Sheet and strip. Unless otherwise specified in the contract or order, sheet material shall be marked in accordance with MIL-STD-190, and to show the specification number, type and grade, date of manufacture (by calendar quarters), and the manufacturer's code identification and compound number. The identification shall appear in rows of constantly recurring symbols from one end of the sheet to the other, spaced approximately 5 inches (127 mm) apart. The manufacturer's code identification and compound number shall appear immediately below the specification number. The symbol shall be clearly legible and not less than .25 inch (6.35 mm) high and shall be applied by using a marking fluid that is not deleterious to the rubber. The marking shall not be obliterated by normal handling nor by the action of lubricating oil.

3.6.2 Molded shapes. When the size of the product permits, the identifying symbol, as in 3.6.1, shall be marked once on each part.

3.6.3 Small parts. Where material dimensions are such that markings cannot be made in accordance with the above, markings shall appear on the container only.

~~3.7 Workmanship. Workmanship shall be of a quality to assure the materials comply with the requirements of this specification.~~

MIL-DTL-3533C
w/AMENDMENT 2
Draft Dated 22 September 2025

TABLE II. Physical properties.

PROPERTY	TYPE I		TYPE II	
	Grade A	Grade B	Grade A	Grade B
<u>Original</u>				
Tensile Strength-psi (MPa) min.....	1850 (12.78)	1650 (11.38)	2000 (13.79)	1800 (12.41)
Ultimate Elongation—% min.....	200	300	250	350
Tear Resistance-lbs/in (Kg/mm) thickness min.....	25 (.446)	35 (.625)	210 (3.750)	250 (4.464)
Tension Set — 200% elongation—% max.....	..	..	12	..
300% elongation—% max.....	..	..	..	15
Tensile Modulus—300% elongation—psi (MPa) min.....	..	..	..	1000 (6.89)
Permanent Set—150 elongation—% max.....	2	2	..	..
Compression Set-25% deflection-% max.....	..	..	10	10
Crush Test—5600 lb (2540.12 Kg) load—% recovery min.....	90	90	..	..
Temperature Retraction—50% elongation and 10% recovery— °F (°C) max.....	-10 (-5.6)	-20 (-11.1)	..	..
Hardness — Shore "A" points.....	80 ± 5	70 ± 5	80 ± 5	70 ± 5
<u>Air Aged — 168 ± 1 hr at 158 ± 4°F (70 ± 2°C)</u>				
Tensile Strength - psi (MPa) min.....	1750 (12.07)	1500 (10.34)	1900 (13.10)	1700 (11.72)
Ultimate Elongation - % min.....	175	275	225	325
Tension Set—200% elongation - % max.....	..	..	15	..
300% elongation - % max.....	..	..	..	18
Permanent Set — 150% elongation - % max.....	2	2	..	..
Crush Test — 5600 lb (2540.12 Kg) load - % recovery min.....	85	85	..	..
Hardness Change-Shore "A" points — max.....	± 5	± 5	± 5	± 5
<u>Oil Aged — 168 ± 1 hr at 158 ± 4°F (70 ± 2°C)</u>				
Tensile Strength — psi (MPa) min.....	1700 (11.72)	1500 (10.34)	1900 (13.10)	1700 (11.72)
Ultimate Elongation — % min.....	175	275	225	325
Tension Set—200% elongation — % max.....	..	..	15	..
300% elongation — % max.....	..	..	..	20
Permanent Set — 150 elongation — % max.....	4	4	..	..
Crush Test — 5600 lb (2540.12 Kg) load — % recovery min.....	80	80	..	..
Temperature Retraction — 50% elongation and 10% retraction — °F (°C) max.....	+10 (+5.6)	0	..	..
Volume Change — % max.....	± 8	± 8	± 10	± 10
Hardness Change —Shore "A" Points — max.....	± 10	± 10	± 10	± 10
<u>Synthetic Sea Water Aged — 168 ± 1 hr at 158 ± 4°F (70 ± 2°C)</u>				
Tensile Strength — psi (MPa) min.....	1750 (12.07)	1500 (10.34)	1900 (13.10)	1700 (11.72)
Ultimate Elongation — % min.....	175	225	225	325
Crush Test —5600 lb (2540.12 Kg) load - % recovery min.....	85	85	..	..
Volume Change — % max.....	± 5	± 5	± 5	± 5
Hardness Change — Shore "A" Points- max.....	± 5	± 5	± 5	± 5

Note: The symbol "." means that test is not applicable.

4. VERIFICATION

4.1 Sampling.

4.1.1 Lot. A lot shall consist of all the material of any one type and one grade produced from the same batch of rubber compound submitted at one time. A batch shall be the quantity of material processed through a mill or mixer during a single run and used to fabricate parts, sheets or strips.

4.1.2 Sampling for lot inspections. From each lot a random sample shall be selected in accordance with ASQ Z1.4.

4.1.3 Sampling for conformance testing. The manufacturer shall furnish the necessary samples molded from the same material and under the same conditions as that used in the finished product. When Type I material is specified on the order, the testing samples shall consist of eighteen O-rings (Size No. 214 of SAE AS568) and twelve compression molded discs $.250 \pm .005$ inch ($6.35 \pm .127$ mm) thick and not less than one inch (25.4 mm) in diameter. When Type II material is specified, the samples shall be four 6 by 6 by $.075 \pm .005$ inch (152.4 by 152.4 by $1.905 \pm .127$ mm) platen sheets, three compression set discs $.500 \pm .010$ inch ($12.7 \pm .254$ mm) thick and $1.129 \pm .005$ inch ($28.677 \pm .127$ mm) in diameter, and twelve compression molded discs $.250 \pm .005$ ($6.35 \pm .127$ mm) inch thick and not less than one inch (25.4 mm) in diameter.

4.2 Inspection.

4.2.1 Dimensions, finish, marking and workmanship. Each unit of the sample selected in accordance with 4.1.2 shall be carefully examined to ensure conformance with respect to dimensions, finish, marking and workmanship. The number of nonconforming units shall be recorded and the lot rejected without testing if the number of defective units in the sample equals or exceeds the rejection number specified in ASQ Z1.4.

4.3 Classification of tests.

4.3.1 Conformance tests. Conformance tests for acceptance shall consist of those tests specified in Table III which are applicable to the type of material submitted and for the "as received" condition only.

4.3.2 Rejection. Failure of any sample of synthetic rubber to conform to one or more of the test requirements of this specification shall be cause for rejection of the lot represented.

4.4 Test methods. Unless otherwise specified, the physical properties listed in Table III shall be determined in accordance with ~~Federal Test Method Standard No. 601~~ **FED-STD-601** or the applicable ASTM standard.

TABLE III. Conformance tests

<u>Property</u>	<u>Applicable type</u>	<u>Test Method</u>
a. Hardness	I and II	ASTM D2240
b. Tensile Strength	I and II	ASTM D412
c. Ultimate Elongation	I and II	ASTM D412
d. Tensile Stress	I and II	ASTM D412
e. Tear Resistance	II	ASTM D624
	I	4.4.3
f. Compression Set	II	ASTM D395
g. Crush Test	I	4.4.4
h. Tension Set	II	ASTM D412
i. Permanent Set	I	4.4.5
j. Temperature Retraction	I	4.4.6
k. Low Temperature Flexibility	II	4.4.7
l. Adhesion & Corrosion	II	4.4.8
m. Volume Change	I and II	4.4.10.3

4.4.1 Hardness. Hardness of the compound shall be determined as specified in [Table III](#) except that test samples shall be three compression molded discs $.250 \pm .005$ ($6.35 \pm .127$ mm) inch thick and not less than one inch in diameter. Hardness checks shall not be made on actual gaskets.

4.4.2 O-Ring tests. Tests specified for O-Rings (Type I material) shall be performed on the actual samples of rings submitted for acceptance testing, when possible.

4.4.3 Tear resistance. Tear resistance shall be measured in two planes on separate samples; one with the mold seam and the second at right angles to the mold seam. A minimum of two samples shall be tested. In conducting the test, the O-Ring shall first be severed to open the ring. A cut shall then be made through the center of the cross-sectional diameter of one end. Lengthwise, this cut shall be about 1.25 inches (31.75 mm), sufficient to allow the two halves formed to be inserted into the jaws of a testing machine (Scott tester, or equivalent). The tear resistance shall be calculated as follows:

Tear resistance, pounds per inch of thickness = F / T

Where: F = minimum tearing force in lbs

T = thickness of the specimen in inches

4.4.4 Crush test (Type I only). Three O-Rings shall be selected at random for testing. They shall be twisted (inside out) one-half turn about the central axis of the cross section and then placed in separate locations between two rigid steel plates having a surface roughness of 32 to 63 inches (812.8 to 1600.2 mm) rms. (in accordance with standard ASME B46.1). An axial compression load of 16,800 pounds (7620.35 Kg) (or 5600 (2540.12 Kg) pounds for each ring in the layer) shall be applied. The plates shall be secured to maintain this load for 20 hours by a suitable means (mechanical fixture). The rings shall then be removed and inspected immediately for cracking or disintegration. Following this inspection, the rings shall be stored at room temperature in the free condition and the percent recovery of the ring cross section determined at the end of six hours. No cracking or disintegration shall be evident and the cross-sectional dimensions of the O-Rings shall have attained the values specified in [Table II](#) in respect to the "as manufactured" size at the thinnest section.

4.4.5 Permanent set (Type I only). Permanent set on three O-Rings shall be made by measuring the ID and then stretching over a tapered cone (lubricated with ASTM No. 1 oil) until the ID of the seal has been stretched 150% (if the ID measures .984 inch (25 mm), the ring shall be stretched to 2.460 inches (62.484 mm) ID). The ring shall be held in this stretched state for ten minutes, removed from the cone, and the ID determined after ten minutes rest. Permanent set shall be calculated from the as-measured ID before and after the test. Any breaking or cracking of the test samples shall be cause for rejection.

4.4.6 Temperature retraction (Type I only). This test shall be in accordance with ASTM D1329 except that O-Ring samples (Size No. 214 of SAE AS568) shall be used and three samples tested. After installation, samples shall be elongated 50% as determined by the rod markings and the rate of warming shall be 1°F ($.6^{\circ}\text{C}$) per minute. The temperature retraction 50/10 reading of these seals shall be determined and recorded.

4.4.7 Low temperature flexibility (Type II only). This test shall be in accordance with ASTM D746 except that the thickness of the samples shall be $.075 \pm .005$ inch ($1.905 \pm .127$ mm). The test temperature for exposure of the samples shall be $1.4 \pm 4^{\circ}\text{F}$ ($-17 \pm 2^{\circ}\text{C}$).

4.4.8 Adhesion and corrosion. Specimens shall be tested in accordance with Method 14211 of ~~Federal Test Method Standard No. 601~~ **FED-STD-601**. For Type I material, the actual O-Ring shall be used for the test specimen in place of the one inch square specimen.

4.4.9 Air aging. Air aging shall be conducted in accordance with ASTM D573.

4.4.10 Aging in liquids. Specimens shall be aged in accordance with Method 6001 of ~~Federal Test Method Standard No. 601~~ **FED-STD-601** using Medium No. 1 for the oil and synthetic sea water for the water medium. Tests shall be conducted for a period of 168 ± 1 hour at a temperature of $158 \pm 4^{\circ}\text{F}$ ($70 \pm 2^{\circ}\text{C}$).

4.4.10.1 Synthetic sea water. The synthetic sea water used in the aging tests shall be formulated as follows:

Sodium Chloride	- 23 grams
Sodium Sulfate Decahydrate	- 8 grams
Stock Solution	- 20 mL
Distilled Water	- To make 1 Liter

4.4.10.1.1 Stock solution. The stock solution used in formulating the synthetic sea water shall have the following composition:

Potassium Chloride	- 10 grams
Potassium Bromide	- 45 grams
Magnesium Chloride Sexahydrate	- 550 grams
Calcium Chloride Sexahydrate	- 110 grams
Distilled Water	- To make 1 Liter

4.4.10.2 Tensile strength and ultimate elongation. Tensile strength and ultimate elongation property determinations after liquid aging shall be performed in accordance with Method 6121 of ~~Federal Test Method Standard No. 601~~ **FED-STD-601** except that a recovery period of twenty hours in the original test liquids will be allowed.

4.4.10.3 Volume change. Changes in volume after liquid aging shall be performed in accordance with Method 6211 of ~~Federal Test Method Standard No. 601~~ **FED-STD-601**. O-Ring samples shall be used for Type I material and compression molded discs .250 ± .005 inch (6.35 ± .127 mm) thick and not less than one inch in diameter shall be used for Type II material. The discs used for hardness tests may also be used for volume change determinations. Tests shall be run in triplicate.

5. PACKAGING

5.1 Packaging. For acquisition purposes, the packaging requirements shall be as specified in the contract or order (see 6.2). When packaging of materiel is to be performed by DoD or inhouse contractor personnel, these personnel need to contact the responsible packaging activity to ascertain packaging requirements. Packaging requirements are maintained by the Inventory Control Point's packaging activities within the Military Service or Defense Agency, or within the military service's system commands. Packaging data retrieval is available from the managing Military Department's or Defense Agency's automated packaging files, CD-ROM products, or by contacting the responsible packaging activity.

6. NOTES

(This section contains information of a general or explanatory nature that may be helpful, but is not mandatory.)

6.1 Intended use. Synthetic rubber covered by this specification is intended for all types of synthetic rubber gaskets and seals for torpedo use.

6.2 Acquisition requirements. Acquisition documents should specify the following:

- Title, number, and date of this specification.
- Type and grade of material required (see 1.2)
- Form of material required (see 3.2)
- Dimensions required (see 3.2.1 and 3.2.2).
- Shape required (see 3.2.2).
- Tolerance for cut or molded material (see 3.2.2).
- Marking required (see 3.7).
- Packaging requirements (see 5.1).

6.3 Shelf-life. This specification covers items where the assignment of a Federal shelf-life code is a consideration. Specific shelf-life requirements should be specified in the contract or purchase order, and should include, as a minimum, shelf-life code, shelf-life package markings in accordance with MIL-STD-129 or FED-STD-123, preparation of a material quality storage standard for type II (extendible) shelf-life items, and a minimum of 85 percent shelf-life remaining at time of receipt by the Government. These and other requirements, if necessary, are in DoD 4140.27-M, *Shelf-life Management Manual*. The shelf-life codes are in the Federal Logistics Information System Total Item Record. Additive information for Shelf-life management may be obtained from DoD 4140.27-M, or the designated shelf-life Points of Contact (POC). The POC should be contacted in the following order: (1) the Inventory Control Points that manage the item and (2) the DoD Services and Agency administrators for the DoD Shelf-Life Program. Appropriate POCs for the DoD Shelf-Life program can be contacted through the DoD Shelf-Life Management website: <https://www.shelflife.hq.dla.mil/>.

6.4 Subject term (key word) listing.

O-Ring
Torpedo
Vulcanized elastomeric compound

6.5 Amendment notations. The margins of this specification are marked with vertical lines to indicate modifications generated by this amendment. This was done as a convenience only and the Government assumes no liability whatsoever for any inaccuracies in these notations. Bidders and contractors are cautioned to evaluate the requirements of this document based on the entire content irrespective of the marginal notations.

CONCLUDING MATERIAL

Custodians:
Army – MR
Navy - OS
Air Force -71

Preparing activity:
DLA – CC

(Project 5330-2025-008)

Review activities:
Army - AR, MI
Navy - AS

NOTE: The activities listed above were interested in this document as of the date of this document. Since organizations and responsibilities can change, you should verify the currency of the information above using the ASSIST Online database at <https://assist.dla.mil>.